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PCT/GB2005/000730



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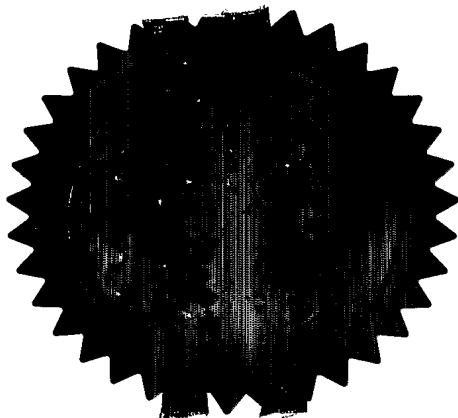
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## Patents Form 1/77

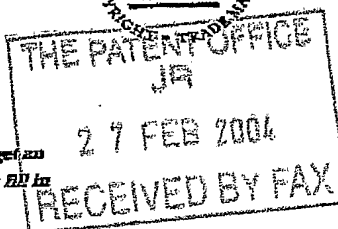
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P01/7700 0.00-0404275.0 ACCOUNT CHA

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P2358/1/GB

2. Patent application number

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0404275.0

27 FEB 2004

3. Full name, address and postcode of the or of each applicant (underline all surnames)

Kenmore UK Limited  
Prospect Road  
Crook  
Co. Durham DL15 8JN

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

a company registered in England

4. Title of the invention

Cooling Apparatus

5. Name of your agent (if you have one)

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

Castles  
1 King Street  
Bakewell  
Derbyshire DE45 1DZ

Patents ADP number (if you know it)

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number  
(if you know it)

Date of filing  
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7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
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8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

Yes

a) any applicant named in part 3 is not an inventor, or

b) there is an inventor who is not named as an applicant, or

c) any named applicant is a corporate body.

See note (d))

Patents Form 1/77



## Patents Form 1/77

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## Continuation sheets of this form

Description

5

Claim(s)

2

Abstract

1

Drawing(s)

3

10. If you are also filing any of the following, state how many against each item.

## Priority documents

## Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

Request for preliminary examination and search (Patents Form 9/77)

1

Request for substantive examination (Patents Form 10/77)

1

Any other documents (please specify)

11.

I/We request the grant of a patent on the basis of this application.

Signature

G. J. Buckley

Castles

Date

27/2/74

12. Name and daytime telephone number of person to contact in the United Kingdom

G J Buckley 01629-813505

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## DUPLICATE

## Cooling Apparatus

This invention is concerned with cooling apparatus and method of their manufacture. More particularly, this invention is specifically concerned with cooling apparatus selected from  
5 refrigerators and freezers comprising tube evaporator systems which under operating conditions circulate refrigerants at below freezing temperatures.

Domestic refrigerators and freezers are generally of a similar design, each including an insulated chiller or freezer box, accessible by a door, and means for cooling the interior of  
10 the box. Conventionally, the means for cooling the interior of the box is a heat exchanger including a tube evaporator system, wherein a first part of the system is located inside of the box and a second part of which is located outside of the box.

Under normal operating conditions, refrigerant is circulated through the first part of the  
15 system at temperatures of less than 0°C, typically -5 to -50 °C. If the system is being used in a refrigerator, the circulating temperature of the refrigerant in the first part of the system is usually -5 to -15 °C, whereas if the system is being used in a freezer, the circulating temperature of the refrigerant in the first part of the system is usually -15 to -50 °C.

At least the first part of the tube evaporator system, i.e. the part of the system which in use  
20 is exposed to sub-zero temperatures, has historically been manufactured from steel or copper tubes connected by lap joints employing a high temperature brazing flux and solder to seal the joint. The joining procedure which is the current standard practiced for high temperature brazing, is typically set out in British Standard 1723, Part 2, 1986, or its  
25 foreign equivalent standards

The joining procedure, typically set out in British Standard 1723, Part 2, 1986, is intended to produce a gas tight metallic seal between two similar metal tubes (steel-to-steel or copper-to-copper) or dissimilar metal tubes (steel-to-copper) by introducing a molten filler  
30 material into the joint area, which subsequently sets hard. In summary, the end of one of the tubes enters the other for a distance of between 5 and 20 mm by one end being expanded to form a lap joint (e.g. Fig 1). The clearance between the tube interfaces is adapted to allow maximum penetration of the filler material during subsequent brazing or



soldering operations. In accordance with the Standard, the filler material is a high-temperature brazing metal or solder, which requires temperatures in excess of 350 °C, typically greater than 450°C to effect the seal. Whilst the high temperature required to effect the seal is usually provided by the flame brazing method, whereby a flame is supplied from a brazing torch with e.g. an oxygen and acetylene source (e.g. Fig 2), other methods such as induction or resistance brazing may also be used. The filler material is manually applied using e.g. a solder rod to the join of the two heated tubes and melts at an appropriate temperature in a way that allows the filler material to run freely around the circumference of the tubes allowing capillary action to pull the filler metal into the joint interface between the tubes (e.g. Fig 3). This completes the process as cooling allows the molten filler to form a leak tight seal around the joint of the tubes (e.g. Fig 4).

The use of high temperature brazing metals or solders for joining the tubes means that a high amount of energy is consumed in the process. Further, because of the labour intensive manual nature of the process and the fact that a long heating time is required to get the tubes to the high processing temperature, the process is also time consuming.

Low temperature solders, such as tin alloys, are well known and have been used for many years in forming lap joints between tubes in e.g. tube evaporating systems employed in air conditioning systems, wherein the coolant is circulated in the system at temperatures above 0°C. Such low temperature solders typically comprise tin, to either a greater or lesser extent. Tube evaporator system manufacturers have been prejudiced against using tin alloy solders in systems intended for use in refrigerators and freezers, where the operating temperature of the seal can be well below 0°C, as it being perceived that such "soft" solders would be too weak to provide the tensile strength of the joint required in such low temperature applications. The existence of this prejudice is perhaps evidenced by the fact that such systems are presently manufactured typically to British Standard 1723, Part 2, 1986 or its foreign equivalent standards.

It is an object of the present invention to provide cooling apparatus which can be manufactured in a more energy and time efficient manner.

In accordance with the present invention, there is provided a cooling apparatus comprising an insulated chiller or freezer box, accessible by a door, and means for cooling the interior of the box, said means comprising a heat exchanger including a tube evaporator system, wherein a first part of the system is located inside of the box and a second part of which is  
5 located outside of the box, wherein said system comprises a plurality of tubes connected to provide a pathway for a refrigerant which in use is circulated between said first part and said second part of said system; characterised in that:  
the metal tubes of the system which in use contact refrigerant which is at a temperature of 0°C or less are connected by lap joints sealed in a gas tight manner by a solder which has a  
10 melting temperature of from 180 to 300°C, preferably from 200 to 260 °C, more preferably from 220 to 250 °C.

It is believed that any solder which has a melting temperature in the relevant range and which is compatible with the metal tubes will be suitable for use in the present invention.  
15 A person skilled in the art will readily know what types of solders are compatible for use with tubes of a given metal or metals. When the tubes are copper or steel, the solder is preferably a tin alloy solder, preferably a tin alloy solder comprising at least 80% by wt Sn, more preferably at least 95 % by wt Sn. In one embodiment, the solder may comprise at least 99 wt% Sn, for example the solder may comprise 99 % Sn and 1% Cu.

20 In another aspect, the present invention provides a cooling apparatus comprising an insulated chiller or freezer box, accessible by a door, and means for cooling the interior of the box, said means comprising a heat exchanger including a tube evaporator system, wherein a first part of the system is located inside of the box and a second part of which is  
25 located outside of the box, wherein said system comprises a plurality of tubes connected to provide a pathway for a refrigerant which in use is circulated between said first part and said second part of said system; characterised in that:  
the metal tubes of the system which in use contact refrigerant which is at a temperature of 0°C or less are connected by lap joints sealed in a gas tight manner by a tin alloy solder,  
30 preferably a tin alloy solder comprising at least 80% by wt Sn, more preferably at least 95 % by wt Sn. In one embodiment, the solder may comprise at least 99 wt% Sn, for example the solder may comprise 99 % Sn and 1% Cu. Preferably, the tin alloy solder has a melting

temperature of from 180 to 300°C, preferably from 200 to 260 °C, more preferably from 220 to 250 °C.

- In another aspect, there is provided a method for manufacturing cooling apparatus
- 5 comprising an insulated chiller or freezer box, accessible by a door, and means for cooling the interior of the box, said means comprising a heat exchanger including a tube evaporator system, wherein a first part of the system is located inside of the box and a second part of which is located outside of the box, wherein said system comprises a plurality of tubes connected to provide a pathway for a refrigerant which in use is circulated between said
- 10 first part and said second part of said system; the method being characterised in that: the metal tubes of the system which in use contact refrigerant which is at a temperature of 0°C or less are joined by a process comprising:
- preparing a lap joint between two of said tubes and sealing said tubes in a gas tight manner with a solder having a melting temperature of from 180 to 300°C, preferably from 200 to
- 15 260 °C, more preferably from 220 to 250 °C. Preferably, the solder is a tin alloy solder, preferably a tin alloy solder comprising at least 80% by wt Sn, more preferably at least 95 % by wt Sn. In one embodiment, the solder may comprise at least 99 wt% Sn, for example the solder may comprise 99 % Sn and 1% Cu.
- 20 One of the metal tubes used to form the lap joint preferably comprises steel or copper and the other metal tube also preferably comprises steel or copper. More preferably, both of said tubes comprise the same metal.

- Because a low temperature solder is used in the present invention, manufacturers can make
- 25 significant labour and energy savings.

- The cooling apparatus of the present invention may be a refrigerator or other apparatus which in use maintains the temperature within the insulated box at about 0°C or a few degrees above 0°C, such as a drinks chiller, or it may be a freezer or other apparatus which
- 30 in use maintains the temperature within the insulated box below 0°C.

In one particular embodiment of the method of the present invention, the female tube of the tubes forming the lap joint is presented with a flare for receiving solder (e.g. Fig 5).

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Preferably, the solder is presented in the form of a solder ring, which is seated manually at the joint site around the male tube of the tubes forming the lap joint and then heated and melted, whereby the solder fills the interstices between the tubes (e.g. Fig 6). Preferably, the solder is heated and melted by heat from a heat gun, which is capable of providing hot air circulation around the joint (e.g. Fig 7). When cooled, the solder solidifies and forms an air-tight seal between the tubes, so forming the finished joint (e.g. Fig 8). These embodiments enable significant time savings in the manufacture of the systems.

In one embodiment of the present invention, all the joints of the tubes used in the manufacture of tube evaporator system are prepared using the low temperature solder.

### Claims

1. A cooling apparatus comprising an insulated chiller or freezer box, accessible by a door, and means for cooling the interior of the box, said means comprising a heat  
5 exchanger including a tube evaporator system, wherein a first part of the system is located inside of the box and a second part of which is located outside of the box, wherein said system comprises a plurality of tubes connected to provide a pathway for a refrigerant which in use is circulated between said first part and said second part of said system; characterised in that:  
10 the metal tubes of the system which in use contact refrigerant which is at a temperature of 0°C or less are connected by lap joints sealed in a gas tight manner by a solder which has a melting temperature of from 180 to 300°C.
2. A cooling apparatus comprising an insulated chiller or freezer box, accessible by a  
15 door, and means for cooling the interior of the box, said means comprising a heat exchanger including a tube evaporator system, wherein a first part of the system is located inside of the box and a second part of which is located outside of the box, wherein said system comprises a plurality of tubes connected to provide a pathway for a refrigerant which in use is circulated between said first part and said second part of said system;  
20 characterised in that:  
the metal tubes of the system which in use contact refrigerant which is at a temperature of 0°C or less are connected by lap joints sealed in a gas tight manner by a tin alloy solder.
3. A method for manufacturing cooling apparatus comprising an insulated chiller or  
25 freezer box, accessible by a door, and means for cooling the interior of the box, said means comprising a heat exchanger including a tube evaporator system, wherein a first part of the system is located inside of the box and a second part of which is located outside of the box, wherein said system comprises a plurality of tubes connected to provide a pathway for a refrigerant which in use is circulated between said first part and said second part of said  
30 system; the method being characterised in that:  
the metal tubes of the system which in use contact refrigerant which is at a temperature of 0°C or less are joined by a process comprising:

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preparing a lap joint between two of said tubes and sealing said tubes in a gas tight manner with a solder which has a melting temperature of from 180 to 300°C and/or is a tin alloy solder.

- 5     4.     A cooling apparatus as claimed in claim 1 or claim 2 or a method as claimed in claim 3, wherein the solder comprises at least 80% by wt tin.
5.     A cooling apparatus as claimed in claim 1 or claim 2 or a method as claimed in claim 3, wherein the solder comprises at least 95% by wt tin.
- 10     6.     A cooling apparatus as claimed in claim 1 or claim 2 or a method as claimed in claim 3, wherein the solder melts in the range of from 200 to 250°C.
- 15     7.     A cooling apparatus as claimed in claim 1 or claim 2 or a method as claimed in claim 3, wherein the solder melts in the range of 220 to 240°C.
8.     A cooling apparatus as claimed in claim 1 or claim 2 or a method as claimed in claim 3, wherein the solder comprises at least 80% by wt tin and melts in the range 200 to 250°C.

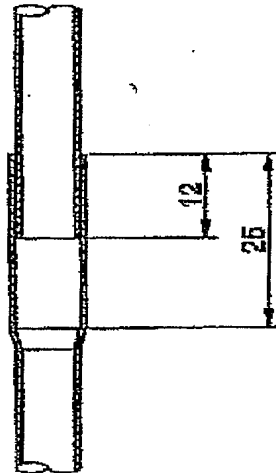
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### Abstract

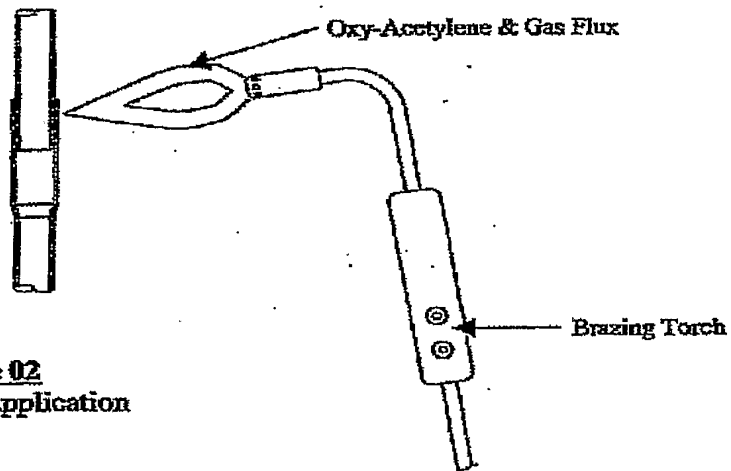
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#### Cooling Apparatus

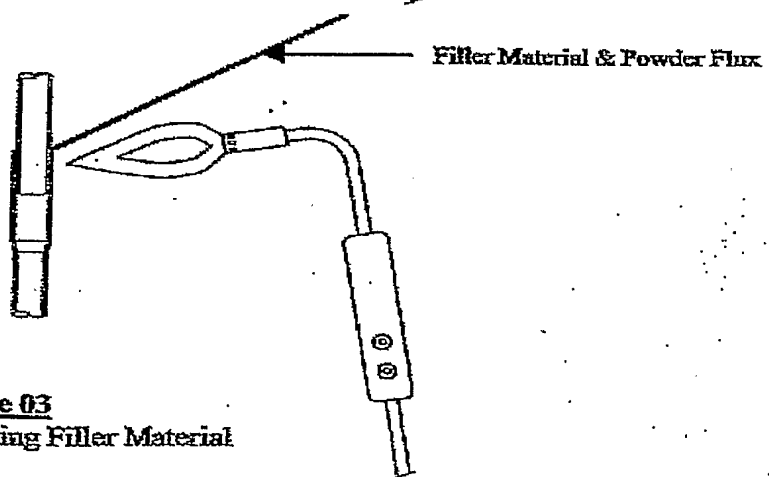
A cooling apparatus, e.g. a refrigerator or a freezer, comprises an insulated chiller or freezer box, accessible by a door, and means for cooling the interior of the box, said means comprising a heat exchanger including a tube evaporator system, wherein a first part of the system is located inside of the box and a second part of which is located outside of the box, wherein said system comprises a plurality of tubes connected to provide a pathway for a refrigerant which in use is circulated between said first part and said second part of said system. The metal tubes of the system which in use contact refrigerant which is at a temperature of 0°C or less are connected by lap joints sealed in a gas tight manner by a solder which a) has a melting temperature of from 180 to 300°C and/or b) is a tin solder.

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**Figure 01**  
Tubes Assembled Prior to  
Heat Application



**Figure 02**  
Heat Application



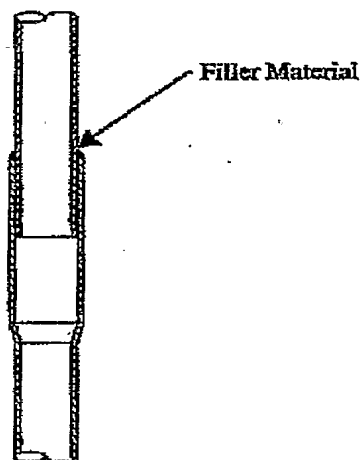
**Figure 03**  
Applying Filler Material



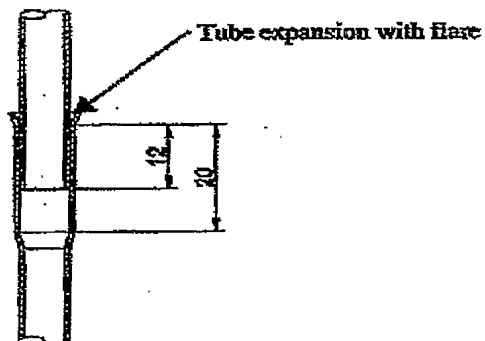


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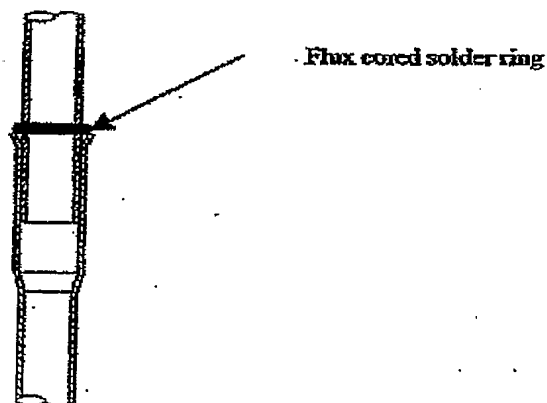
**Figure 04**  
Finished Joint



**Figure 05**  
Tubes assembled prior to  
heat application



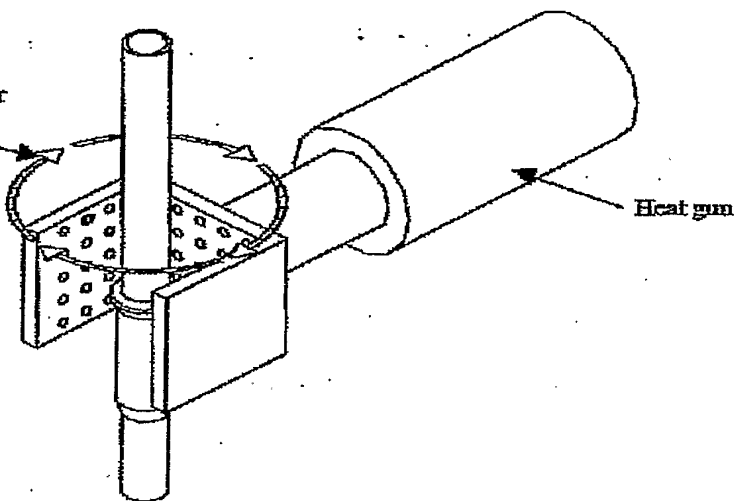
**Figure 06**  
Filler material application





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Hot air circulation  
around joint and filler  
material



**Figure 07**  
Heat application

**Figure 08**  
Finished joint

